CLAIMS

What is claimed is:

1. A system for providing integrated control of multiple well tools, comprising:

at least three hydraulically controlled well tool devices; and

a pair of hydraulic control lines coupled to the at least three hydraulically controlled well tool devices, wherein the at least three hydraulically controlled well tool devices are independently controllable via application of at least one unique pressure level in at least one of the pair of hydraulic control lines.

2. The system as recited in claim 1, wherein the at least three hydraulically controlled well tool devices comprise six hydraulically controlled well tool devices.

3. The system as recited in claim 2, wherein a first group of three hydraulically controlled well tool devices are controlled by unique pressure levels in a first hydraulic control line of the pair of hydraulic control lines, and a second group of three hydraulically controlled well tool devices are controlled by unique pressure levels in a second hydraulic control line of the pair of hydraulic control lines.

4. The system as recited in claim 1, wherein each hydraulically controlled well tool device comprises a decoder hydraulically coupled to a corresponding hydraulically controlled well tool, each decoder comprising a main valve that remains open through a predetermined pressure range applied to one of the pair of control lines, the other of the pair of control lines being placed in direct hydraulic communication with the hydraulically controlled well tool when the main valve is open.

5. The system as recited in claim 4, wherein the predetermined pressure range is unique to each decoder controlled by a given hydraulic control line of the pair of hydraulic control lines.

6. The system as recited in claim 5, wherein the predetermined pressure ranges are established by a plurality of unique springs.

7. The system as recited in claim 4, wherein a plurality of the decoders each comprises an accumulator and an accumulator valve to establish a reference pressure with respect to the main valve.

8. The system as recited in claim 4, wherein a plurality of the decoders each comprises a filling valve disposed in parallel to the main valve to equalize any atmospheric pressure trapped in the corresponding hydraulically controlled well tool.

9. The system as recited in claim 4, wherein at least four decoders are connected to at least four hydraulically controlled well tools, and the opening of the main valve in 50 percent of the at least four decoders is controlled by a first of the pair of control lines and the opening of the main valve in the other 50 percent of the at least four decoders is controlled by a second of the pair of control lines.

10. The system as recited in claim 1, wherein the at least one unique pressure level comprises two unique pressure levels.

11. The system as recited in claim 1, wherein the at least one unique pressure level comprises three unique pressure levels.

12. A method of controlling downhole tools, comprising:

connecting at least three downhole tools to at least three corresponding main valves that enable selective fluid flow to the at least three downhole tools;

using a first hydraulic line to selectively open any of the at least three corresponding main valves and a second hydraulic line to provide hydraulic input to any of the at least three downhole tools upon opening of the corresponding main valve; and

applying pressure at a unique pressure range within the first hydraulic line to open a specific corresponding main valve.

13. The method as recited in claim 12, wherein applying pressure comprises applying pressure within one of at least two unique pressure ranges.

14. The system as recited in claim 12, wherein applying pressure comprises applying pressure at one of at least three unique pressure ranges.

15. The method as recited in claim 14, further comprising locating each corresponding main valve in a decoder in which a biasing device is used to bias the valve against the pressure applied by the first hydraulic line.

16. The method as recited in claim 15, further comprising deploying an accumulator in each decoder to create a reference pressure acting against the main valve.

17. The method as recited in claim 14, further comprising:

coupling additional downhole tools to additional corresponding main valves;

selectively opening the additional corresponding main valves via the second hydraulic line; and

providing hydraulic input to the additional downhole tools through the first hydraulic line.

18. The method as recited in claim 17, further comprising locating all of the additional corresponding main valves downstream from the at least three corresponding main valves along the first and the second hydraulic control lines.

19. The method as recited in claim 17, further comprising locating the additional corresponding main valves in an alternating arrangement with the at least three corresponding main valves along the first and the second hydraulic control lines.

20. A system of controllable well tools, comprising:

a plurality of downhole well tool components; and

a plurality of fluid control lines, the number of downhole well tool components being at least one more than the number of fluid control lines, wherein the downhole well tool components may be individually controlled by applying pressure in at least one of the fluid control lines at a level within a predetermined pressure range associated with the individual downhole well tool component.

21. The system as recited in claim 20, wherein the plurality of fluid control lines comprises two control lines, and the plurality of downhole well tool components comprises at least four downhole tools.

22. The system as recited in claim 20, wherein the plurality of fluid control lines comprises three control lines, and the plurality of downhole well tool components comprises up to eighteen downhole tools.

23. The system as recited in claim 20, wherein each downhole well tool component comprises a decoder having a spring-loaded valve that is hydraulically actuated, the spring-loaded valve being designed to close if the pressure acting thereon moves above or below a given pressure range.

24. The system as recited in claim 23, wherein a single decoder is associated with a single hydraulically controlled well tool component of the plurality of downhole well tool components.

25. The system as recited in claim 23, wherein a pair of decoders is associated with a single hydraulically controlled well tool having at least two downhole well tool components independently controlled.

26. The system as recited in claim 23, wherein each decoder comprises an accumulator to establish a back reference pressure against the spring-loaded valve.

27. The system as recited in claim 23, wherein each decoder comprises a filling valve to equalize internal and external pressures.

28. The system as recited in claim 23, wherein the plurality of control lines comprises a pair of control lines that crossover between a pair of decoders.

29. The system as recited in claim 23, wherein the plurality of control lines comprises a pair of control lines that crossover between each decoder.

30. A system for controlling downhole tools, comprising:

means for providing selective fluid flow via a fluid command line to at least three fluid actuated downhole tools; and

means for controlling independent actuation of each downhole tool by pressurizing a fluid pilot line to within a predetermined pressure range associated with the actuation of a specific downhole tool.

31. The system as recited in claim 30, wherein the means for providing comprises a main valve.

32. The system as recited in claim 31, wherein the means for controlling comprises a first spring and a second spring position to resist movement of the valve, the second spring being capable of exerting a greater spring force than the first spring.

33. A system for providing integrated control of multiple well tools, comprising:

at least three hydraulically controlled well tool devices; and

a plurality of hydraulic control lines coupled to the at least three hydraulically controlled well tool devices, wherein the at least three hydraulically controlled well tool devices are independently controllable via sequential application of pressure in the plurality of hydraulic control lines, further wherein the number of hydraulically controlled well tools is greater than the number of hydraulic control lines.

34. The system as recited in claim 33, wherein the at least three hydraulically controlled well tool devices comprise at least four hydraulically controlled well

tool devices, and the plurality of hydraulic control lines comprises three hydraulic control lines.

35. The system as recited in claim 33, wherein the at least three hydraulically controlled well tool devices comprises six hydraulically controlled well tool devices, and the plurality of hydraulic control lines comprises three hydraulic control lines.

36. The system as recited in claim 33, wherein each hydraulically controlled well tool device comprises a decoder connected to a tool.

37. A system for providing integrated control of multiple well tool components, comprising:

a plurality of decoders coupled to a plurality of well tool components;

a first control line coupled to the plurality of decoders; and

a second control line coupled to the plurality of decoders, wherein the first and the second control lines each serve as a pilot line and a command line.

38. The system as recited in claim 37, further comprising a crossover disposed between two decoders of the plurality of decoders.

39. The system as recited in claim 37, further comprising a plurality of crossovers disposed between the plurality of decoders.

40. The system as recited in claim 37, wherein the plurality of decoders comprises at least four decoders.

41. The system as recited in claim 37, further comprising a third control line that serves as the pilot line and the command line.

42. A method for providing integrated control of multiple well tool components, comprising:

connecting decoders to a plurality of hydraulically controlled well tool components;

coupling a plurality of control lines to the decoders; and

utilizing each control line of the plurality of control lines as both a pilot line for controlling a decoder and a command line for actuating a hydraulically controlled well tool component.

43. The method as recited in claim 42, wherein coupling comprises coupling two control lines to the decoders.

44. The method as recited in claim 42, further comprising controlling each decoder by applying a unique predetermined pressure level in the pilot line.

45. The method as recited in claim 44, wherein applying a unique predetermined pressure level comprises applying a plurality of unique predetermined pressure levels with each unique predetermined pressure level corresponding to the actuation pressure required to actuate a specific decoder.

46. The method as recited in claim 42, wherein coupling comprises coupling the plurality of control lines to a greater number of decoders than the number of control lines.